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ABSTRACT

Issues and procedures for applying computers to the study of learning from text are discussed in this paper, which notes the advantages and disadvantages of using authoring aids to develop instructional programs, and examines the implications of schema theory for designing effective computer screen displays based on research on text learning. Several variables affecting the memory of facts and principles in text learning are also discussed: organization, level of vocabulary, size of text, illustrations, advance organizers, cues, and objectives. Schema theory and its relevance to the design of textual materials is described, and it is suggested that this theory might offer insights into alternative materials design for the learning handicapped child. Sixteen references are listed. (MES)

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The Use of Computers in Text Research:

Some Reflections on a Seminar

Paper for AECT annual meeting - 1987

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The purpose of this paper is to discuss some of the issues and procedures that developed in a seminar taught by Dr. Robert Gagne and I last spring. The purpose of the seminar was to work with students interested in applying computers to the study of learning from text. There have been numerous studies of text learning, and many different variables have been found to facilitate memory of facts and principles. We wanted to look at these studies and their underlying theories to see what they implied with regard to designing effective computer screen displays.

Why use the computer in text research? The computer is, for the most part, a printed text display medium. The same variables that are manipulated on the printed page, can be manipulated on the computer. Both are capable of presenting words and illustrations and both are capable of presenting questions before, during or after the presentation of text. However, with the computer, presentation is under the control of a program that determines what and when the learner sees next. This is something that is difficult if not impossible with printed text, and researchers have documented the problems of students ignoring or thwarting instructional strategies built into printed texts (R. C. Anderson, 1970).

One problem with using computers as delivery systems in research is the large amount of development time that it takes to create instructional programs. A second problem seems to be a lack of follow-up of research in which they are used. Very often a program is used for only one research study and then it is discarded. In light of the resources spent on programming, the computer doesn't seem to be a very efficient medium for conducting research.

One solution to these problems is to use authoring programs. Authoring programs allow the author to create text and question screens in a relatively straight-forward manner, and the screens can be easily assembled in any number of different sequences for different treatments. Furthermore, since the screens are relatively independent until they are assembled into a lesson, it is easy to modify the screens created for one experiment and use them in another. This feature allows the researcher to build a library of screen displays that could be used by others interested in the same line of research. This facilitates the continuity of research, and allows resources to be used more efficiently. However, one limitation of authoring systems is that they are generally more limited than programs created in a programming language. They often do not offer much flexibility in branching, or in data collection. We found that even with these limitations, the advantages seemed to outweigh the disadvantages.

What variables are associated with text learning?

Prior researchers have manipulated the organization, the level of vocabulary, the size of text, illustrations accompanying the text, advance organizers, cues, objectives, and a number of other variables. Theses effects of these variables were explained by many different theories. R. C. Anderson (1970) postulated that what a student did when confronted with instructional tasks were of crucial importance in determining what the student would learn. To explain the effects of text devices on learning he related them to three stages of learning: attention to the stimulus, encoding the stimulus in a meaningful manner, and conceiving linkages between features of the stimulus that will later serve as cues for retrieval. The implications for the educational technologist are to create displays that ensure that the student will notice the stimulus, translate it into internal speech, evoking images for the things and events named by the words, and conceiving relationships among the imagined things or events.

What is interesting about Anderson's early analysis of devices used to facilitate text learning is that he associates most of them with the process of focusing attention on the stimulus, e.g., the practice of cueing the learner to focus attention on a particular word or phrase by the use of underlining, or the use of embedded questions in text to focus attention on specific content. Few variables were related to the other two processes: encoding the stimulus, and building retrieval cues.

Presently there is considerable interest in schema theory and its implications for the design of textual materials. A schema is considered to be organized knowledge held by the learner, to which new knowledge is related. A basic premise of schema theory is that what a person knows is the major determinant of what he will learn (Anderson, 1984). Schemata theory is not incompatible with the activities previously associated with attention processes, but it seems to focus on variables affecting the second and third processes of learning, namely, cue encoding and associative linkages. However, the devices used by the schema researcher seem to be the same as those previously associated with other learning models, i.e., signals, elaborated stimulus displays, illustrations, embedded questions, etc.

A schema is hypothesized to be accountable for the expectations a learner brings to a learning task. If, for instance, the learner has a good understanding of algebra, a learning task associated with the calculation of the velocity of an accelerating object will be manageable. However, if the student doesn't have an algebra schema, the learning task may be seen as difficult if not impossible. Advance organizers, cues, or embedded questions within the new physics materials will be insufficient to change the situation, short of teaching the student algebra.

On the other hand, possessing a schema may be a necessary but not a sufficient condition for facilitating learning. It is hypothesized that an educational technologist might increase the degree of learning by activating an existing schema possessed by a learner. This activation may be as simple as suggesting an organizing idea or title for the material to be learned (see Bransford and Johnson, 1973), or as complex as deriving an analogy for relating the new material to existing knowledge. But how does activation of a schema differ from recall of prerequisite skills, as proposed by R. M. Gagne (1985)? How does it differ from the "preexisting cognitive structure" described by Ausubel? Furthermore, what if analysis (such as a pretest) determines that the learner doesn't possess the prerequisite skills or preexisting knowledge? Obviously, the concept of schema activation is one that needs better definition and further study.

Another variable associated with schema theory is articulation. All learners possess many schemata, each dependent upon the culture and experiences of that learner. Anderson (1984) believes that the schema exists in degrees of articulation. For instance, most males and many females have what might be called a "football" schema. However, it is likely that the males will have a more articulated schema due to cultural characteristics in which males become more knowledgeable about football. With this in mind, one might find that using terminology associated with football in a math word problem might hinder the ability of the female students to answer the question. For example, "The punter kicked the ball to the 20 yard line, if the field is 100 yards long how far must the team go to get a touchdown?" Obviously, accurately answering this question depends not only on math, but on a football schema as well. What is not so obvious is the fact that the same type of mechanism may be working in standard text materials from which children are expected to learn. Vocabulary that is not a part of the underprivileged child's culture (from which their schema are derived) could be as much a barrier as the football jargon would be to the female students.

I am particularly interested in learning problems of children and the learning handicapped. Schema theory might offer some insights into alternative materials design for the learning handicapped child, maybe because these children seem to have such a problem encoding and retrieving new stimulus materials. Is their impoverished schema to blame? Theorists have speculated that the working memory is capable of holding a relatively few pieces of information at a time. If this information is to be encoded and stored in long term memory it must be attached to existing information possessed by the learner, which must also be pulled into working memory. One might speculate that the total capacity of the working memory of the learning handicapped child is less

than that of the normal child, and therefore the amount of new information presented by the environment must be reduced, while at the same time encoding and building associative linkages must be maximized. Can elaborations and cues help to instantiate and tune that schema? These are questions which I hope to address in future research.

The computer seems well suited for the study of many different types of attention devices including cues, questions, and illustrations that can be included where desired within the materials. The computer also seems well suited for the study of variables associated with schema theory. The computer makes it possible to pretest for the degree of articulation of a learner's schema and to branch to different levels of instructional support depending upon the strength of the schema.

Glynn & Britton (1984), Reder (1980) and others have noted that research on the use of text elaboration does not always show the elaborated treatment to be more effective. Glynn & Britton state, "The effect of these devices depends upon whether or not the text actually needs them to be comprehensible." The question facing the designer is, "comprehensible by whom?" While one might agree that educators tend to give too much emphasis to particular elaboration treatments, and not enough thought to the processes supported by these devices. But we do not know much about human information processing, and it is unlikely that we can be very precise in determining where and when specific treatments will and won't be effective.

What directions might text research take? The approach taken in the seminar, was to give the students a number of text passages, from which they could select one to make more memorable. It was obvious that not all the text passages selected were oriented toward the same type of learning outcome. Some were oriented toward information learning, and others toward concepts. It was also obvious that in order to manipulate the text assumptions about the learners (schema) had to be made.

The students were also provided with a reading list (attached) that gave them a start in finding literature related to text learning. The interest of the group seemed to focus on the schema theory, as reflected in the papers in this symposium. Each student chose a theory or proposition of interest to them, and created a CAI presentation to explore the effect of specific text elaborations within the context of that theory. One observation is that the use of the computer often created as many questions as answers with regard to the design of displays. The relatively small text capacity of a computer screen compared to a printed page, the division of the text and necessity for redundancy are variables that are a function of the medium, as much as conscious choice.

With regard to the current state of research on text learning, I feel that it is interesting, but much in need of synthesis. It is likely that schema theory serves to explain one small part of the whole learning process. As a designer I don't feel that the research on schema theory has provided many new guidelines on which to base practice. Perhaps this is due to the complexity of of human behavior. Schema theory research, to date, doesn't give a great deal of consideration to the nature of the text (narrative, expository, argumentation, or descriptive), or the nature of the learning outcomes typically associated with comprehension of these types of text. Educators probably focus more the devices they use in instruction, than they do on the processes served by the devices because we still do not understand these processes very well.

Our experiences in the seminar lead me to encourage other researchers to experiment with the use of the computer as a medium for studying text learning. Authoring programs can relieve much of the drudgery of programming, and open the possibility of creating libraries of materials that can be used by many students. They also give us new perspectives on the application of theory that, perhaps will also help in the clarification of learning processes.

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additional researchers you might investigate:

A. Pavio, W.D. Rohwer, H.T. Taba, W. Estes, R.E. Mayer, J.R. Levin